

Claim Objections

The USPTO also objected to the language in a number of the previously filed claims. The applicants have amended the claims consistent with the suggestions of the Examiner.

Listing of the Claims

Claim 1. (Currently amended) A catalyst for use in stationary or fluid bed dehydrogenation processes for converting hydrocarbons to olefins and/or diolefins, said catalyst ~~comprising~~ consisting essentially of:

a carrier; chromium, as a promoter, in the form of Cr_2O_3 , at a concentration from about 10 wt% to about 30 wt%, based on the total catalyst weight; zirconium, as a promoter, in the form of ZrO_2 , at a concentration from about 0.1 wt% to about 15 wt% zirconium, based on the total catalyst weight; and magnesium, as a promoter, in the form of MgO , at a concentration from about 0.1 wt% to about 15 wt% magnesium, based on the total catalyst weight.

Claim 2. (Original) The catalyst of Claim 1 wherein the carrier is selected from a group consisting of aluminum oxide, alumina, alumina monohydrate, alumina trihydrate, transition alumina, gamma-alumina, delta-alumina, eta-alumina, alumina-silica, silica, silicates, zeolites, bayerite, gibbsite, nordstrandite and combinations thereof.

Claim 3. (Original) The catalyst of Claim 1 wherein the carrier has a surface area of from about $15 \text{ m}^2/\text{g}$ to about $300 \text{ m}^2/\text{g}$, a pore volume of from about 0.2 cc/g to about 1.5 cc/g , and an

average pore diameter of from about 3 nm to about 30 nm.

Claim 4. (Original) The catalyst of Claim 1 wherein the carrier has a particle size of from about 20 μm to about 150 μm .

Claim 5. (Currently amended) The catalyst of Claim 1 wherein the carrier comprises an alumina carrier that is spray-dried or pelletized and calcined at a temperature from about 500°C to about 1100°C.

Claim 6. (Previously presented) The catalyst of Claim 1 wherein the chromium promoter is derived from a member selected from the group consisting of CrO_3 , inorganic chromium salts, ammonium chromate, ammonium dichromate, chromium nitrate, organic chromium salts, and combinations thereof.

Claim 7. (Previously presented) The catalyst of Claim 1 wherein the chromium promoter is present in the form of Cr_2O_3 at a concentration from about 15 wt% to about 28 wt%, based on the total catalyst weight.

Claim 8. (Original) The catalyst of Claim 1 wherein the chromium promoter is added in the form of a CrO_3 solution that is impregnated onto the alumina carrier.

Claim 9. (Cancelled)

Claim 10. (Previously presented) The catalyst of Claim 1 wherein the zirconium promoter is present in the form of ZrO_2 at a concentration of from about 0.5 wt% to about 1.5 wt%, based on the total catalyst weight.

Claim 11. (Original) The catalyst of Claim 1 wherein the zirconium promoter is co-impregnated on the carrier with the chromium promoter.

Claim 12. (Previously presented) The catalyst of Claim 1 wherein the magnesium promoter is present in the form of MgO at a concentration from about 0.1 to about 2 wt%, based on the total catalyst weight.

Claim 13. (Currently amended) ~~The catalyst of Claim 1 further comprising~~ A catalyst for use in stationary or fluid bed dehydrogenation processes for converting hydrocarbons to olefins and/or diolefins, said catalyst consisting essentially of:

a carrier; chromium, as a promoter, in the form of Cr₂O₃, at a concentration from about 10 wt% to about 30 wt%, based on the total catalyst weight; zirconium, as a promoter, in the form of ZrO₂, at a concentration from about 0.1 wt% to about 15 wt% zirconium, based on the total catalyst weight; magnesium, as a promoter, in the form of MgO, at a concentration from about 0.1 wt% to about 15 wt% magnesium, based on the total catalyst weight and from about 0.3 to about 2 wt%, based on the total catalyst weight, of an alkali metal promoter, selected from sodium, potassium and mixtures thereof, expressed in the form of an ~~alkali metal~~ sodium oxide and potassium oxide.

Claim 14. (Cancelled)

15. (Currently amended) A dehydrogenation catalyst ~~comprising~~
consisting essentially of:

a carrier selected from the group consisting of aluminum oxide, alumina, alumina monohydrate, alumina trihydrate, transition alumina, gamma-alumina, delta-alumina, eta-alumina, bayerite, gibbsite, nordstrandite, alumina-silica, silica, silicates, zeolites and combinations thereof, having a surface area from about 15 m²/g to about 300 m²/g, a pore volume from about 0.2 cc/g to about 1.5 cc/g, and an average pore diameter from about 3 nm to about 30 nm; chromium, as a promoter, calculated as Cr₂O₃, at a concentration from about 15 wt% to about ~~20~~ 30wt%, based on the total catalyst weight, wherein the chromium is derived from a member selected from the group consisting of CrO₃, ammonium chromate, ammonium dichromate, chromium nitrate, organic chromium salts, other inorganic chromium salts, and combinations thereof;

zirconium, as a promoter, calculated as ZrO₂, at a concentration from about 0.1 wt% to about 5 wt% zirconium, based on the total catalyst weight; and magnesium, as a promoter, calculated as MgO, at a

concentration from about 0.1 to about 2 wt%, based on the total catalyst weight.

Claim 16. (Previously presented) The catalyst of Claim 15 wherein the chromium promoter is present at a concentration from about 17 wt% to about 24 wt%, based on the total catalyst weight.

Claim 17. (Original) The catalyst of Claim 15 wherein the chromium is added in the form of a CrO_3 solution that is impregnated onto the alumina carrier.

Claim 18. (Previously presented) The catalyst of Claim 15 wherein the zirconium promoter in the form of ZrO_2 is present at a concentration from about 0.5 wt% to about 1.5 wt%, based on the total catalyst weight.

Claim 19. (Previously presented) The catalyst of Claim 15 wherein the magnesium promoter in the form of MgO is present at a concentration from about 0.5 to about 1 wt%, based on the total catalyst weight.

Claim 20. (Original) The catalyst of Claim 15 wherein the zirconium is co-impregnated on the carrier with the chromium and the magnesium.

Claim 21. (Cancelled)

Claim 22. (Cancelled)

Claim 23. (Cancelled)

Claim 24. (Currently amended) A dehydrogenation catalyst ~~comprising~~ consisting essentially of:

a carrier selected from the group consisting of aluminum oxide, alumina, alumina monohydrate, alumina trihydrate, transition alumina, gamma-alumina, delta-alumina, eta-alumina, bayerite, gibbsite, nordstrandite, alumina-silica, silica, silicates, zeolites and combinations thereof, and having a surface area from about 15 m²/g to about 300 m²/g, a pore volume from about 0.25 cc/g to about 0.35 cc/g, and an average pore diameter from about 3 nm to about 30 nm, wherein said carrier is spray-dried or pelletized and calcined;

chromium, as a promoter, calculated as Cr₂O₃, at a concentration from about ~~17~~10 wt% to about ~~24~~30 wt%, based on the total catalyst weight, wherein said chromium is derived from a member selected from the group consisting of CrO₃, ammonium chromate, ammonium dichromate, chromium nitrate, organic chromium salts, other inorganic chromium salts, and combinations thereof, wherein said chromium is added to the support in the form of a CrO₃ solution that is impregnated onto the carrier;

an alkali metal selected from sodium, potassium and mixtures thereof, as a promoter, calculated as an ~~alkali metal~~ sodium oxide and potassium oxide, at a concentration from about 0.3 wt% to about 2 wt%, based on the catalyst weight;

zirconium, as a promoter, calculated as ZrO_2 , at a concentration from about ~~0.5~~0.1 wt% to about ~~1.5~~15 wt% zirconium, based on the total catalyst weight; and magnesium, as a promoter, calculated as MgO , at a concentration from about ~~0.5~~0.1 wt% to about ~~1~~15 wt% magnesium, wherein the magnesium is co-impregnated on the carrier with the chromium and zirconium.

Claim 25. (Cancelled)

Claim 26. (Cancelled)

Claim 27. (Previously presented) The catalyst of Claim 24 wherein the alkali metal promoter comprises about 0.3 to about 1 wt% Na_2O , based on the total catalyst weight.

Claim 28. (New) The catalyst of Claim 13 wherein the alkali metal promoter comprises about 0.3 to about 1 wt% Na_2O , based on the total catalyst weight.